PROCESS CARTRIDGE REMANUFACTURING METHOD

FIELD OF THE INVENTION AND RELATED ART

The present invention relates to a method for remanufacturing a process cartridge. Here, a process cartridge means a cartridge in which a charging means, a cleaning means, and an electrophotographic photoconductive member are integrally disposed, and which is removably mountable in the main assembly of an electrophotographic image forming apparatus.

An electrophotographic image forming apparatus includes electrophotographic copying machines, electrophotographic printers (LED printers, laser beam printers, etc.), electrophotographic facsimileing machines, electrophotographic wordprocessors, etc.

In the field of an electrophotographic image forming apparatus which employs an electrophotographic image formation process, a cartridge system, that is, a system in which a single or plurality of processing means which act on an electrophotographic photoconductive member are integrally disposed in a cartridge removably mountable in the main assembly of an electrophotographic image forming apparatus, has been employed. A cartridge system allows a user to maintain an image forming apparatus without relying on

a service person, drastically improving an image forming apparatus in terms of operational efficiency. Thus, a process cartridge system has been widely used in the field of an electrophotographic image forming apparatus.

A process cartridge, such as the above described one uses developer to form an image on recording medium. In other words, an image formation process consumes developer. Thus, as the amount of the developer in a process cartridge is reduced by consumption to an amount too small for forming images satisfactory to a user who purchased the process cartridge, the process cartridge loses its commercial value.

Thus, there have been known various methods for remanufacturing a process cartridge. One of such methods is disclosed in Japanese Laid-open Patent Application 7-140866.

The process cartridge manufacturing disclosed in this patent includes a process for suctioning out the toner in the toner bin of a process cartridge, through the opening for allowing the toner removed from a photoconductive drum by a cleaning blade, to enter the toner bin.

SUMMARY OF THE INVENTION

There has been desired a simple method for

remanufacturing a process cartridge, which has lost its commercial value due to the consumption of the developer therein, into a commercially viable process cartridge.

The primary object of the present invention is to provide a simple method for remanufacturing a process cartridge.

Another object of the present invention is to provide a method for remanufacturing a process cartridge, the amount of the developer in which has been reduced by consumption to a level at, or below, which it is impossible to form images satisfactory to a user, into a commercially viable process cartridge.

These and other objects, features, and advantages of the present invention will become more apparent upon consideration of the following description of the preferred embodiments of the present invention, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a vertical sectional view of an electrophotographic color image forming apparatus, at a plane parallel to the lateral walls of the electrophotographic image forming apparatus.

Figure 2 is a vertical sectional view of the left end portion of the process cartridge, at a plane

parallel to the lateral walls of the image forming apparatus.

Figure 3 is a perspective view of the process cartridge, as seen from the left side.

Figure 4 is a perspective view of the process cartridge, as seen from the right side.

Figure 5 is a plan view of the left side of the process cartridge, for showing the structure of the drum shutter of the process cartridge.

Figure 6 is a horizontal sectional view of the removed developer storage box of the process cartridge.

Figure 7 is a plan view of the left side of the process cartridge, from which the left side cover has been removed.

Figure 8 is a perspective view of the process cartridge, for showing how to remove pins.

Figure 9 is a perspective view of the process cartridge, for showing how to remove the photoconductive member unit from the process cartridge (cartridge frame).

Figure 10 is a perspective view of the process cartridge, for showing how to remove the shutter from the process cartridge (cartridge frame).

Figure 11 is also a perspective view of the process cartridge, for showing how to remove the shutter from the process cartridge (cartridge frame).

Figure 12 is a perspective view of the process cartridge, for showing how to remove the charge roller unit from the process cartridge (cartridge frame).

Figure 13 is a perspective view of the process cartridge, for showing how to remove the side covers from the process cartridge (cartridge frame).

Figure 14 is a perspective view of the process cartridge, for showing how to remove the photoconductive drum from the process cartridge (cartridge frame).

Figure 15 is a perspective view of the process cartridge, for showing how to remove the cleaning blade and developer catching sheet from the process cartridge (cartridge frame).

Figure 16 is a perspective view of the process cartridge, for showing how to remove the cleaning (sweeping) blade from the process cartridge (cartridge frame).

Figure 17 is a perspective view of the process cartridge, for showing how to remove the removed developer in the process cartridge (cartridge frame).

Figure 18 is a perspective view of the process cartridge, for showing how to remove the side cover from the transfer member unit.

Figure 19 is a perspective view of the

process cartridge, for showing how to remove the bladed wheel unit from the transfer member unit.

Figure 20 is a perspective view of the process cartridge, for showing how to remove the removed developer which is in the transfer member unit.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Embodiment 1)

Hereinafter, the preferred embodiments of the present invention will be described in detail with reference to the appended drawings. In the following descriptions of the embodiments, the "front side" of the image forming apparatus means the upstream side of the apparatus in terms of the direction in which recording medium is conveyed from the transfer process to the fixation process (right-hand side in Figure 1). The "left or right side" of the main assembly of the image forming apparatus, or those of the process cartridge, means the left or right side thereof as seen from the front side of the apparatus. The "lengthwise direction" means the direction parallel to the surface of the recording medium and intersectional (virtually perpendicular) to the direction in which the recording medium is conveyed. The referential numbers in the following descriptions are for referring to drawings, and are not intended to limit

in structure the items to which they are assigned.

First, referring to Figure 1, the general structure of the color image forming apparatus in this embodiment, and the image forming operation thereof, will be described. Figure 1 is a vertical sectional view of an image forming apparatus in accordance with the present invention, which in this embodiment is an electrophotographic full-color laser beam printer employing four developers different in color, for showing the general structure thereof.

As shown in Figure 1, the color image forming apparatus A in this embodiment comprises: an electrophotographic photoconductive drum 1; an exposing means 3 which projects an optical image in accordance with image formation information, onto the photoconductive member 1; and a developing apparatus 4 having a plurality of developing devices which are for developing an electrostatic latent image on the photoconductive member 1, and are different in the color in which they develop the electrostatic latent image. It also comprises an intermediary transferring apparatus having: a transfer belt 5a onto which the developer images different in color are temporarily transferred; and a transfer roller, as the secondary transferring means, for transferring the developer images on the transfer belt 5a, onto a recording medium P, for example, a piece of recording paper, OHP

sheet, fabric, etc. Further, it comprises: a fixing apparatus 8 having a pressure roller and a heat roller; a conveying means for conveying the recording medium P to the transferring apparatus 5 and fixing apparatus 8, in the listed order, and then, discharging it from the image forming apparatus; etc.

Next, the details of the image formation process of the color image forming apparatus A will be described.

The photoconductive member 1 is rotated in the direction (counterclockwise direction) indicated by an arrow mark in Figure 1, in synchronism with the rotation of the transfer belt 5a. As the photoconductive member 1 is rotated, the peripheral surface of the photoconductive member 1 is uniformly charged by a charging apparatus 2. Then, the uniformly charged portion of the peripheral surface of the photoconductive drum 1 is exposed to a beam of light projected, while being modulated with the image formation information regarding, for example, yellow component of an intended image, from the exposing means 3. As a result, an electrostatic latent image in accordance with the image formation information regarding the yellow component is formed on the photoconductive member 1.

The exposing means 3 is a means for exposing the photoconductive member 1 to an optical image of an

intended image by projecting onto the photoconductive member 1 a beam of light while modulating the beam of light with the image formation information read in through an external apparatus or the like. It comprises a laser diode, a polygon mirror, a scanner motor, a focusing lens, and a reflection mirror. As image formation signals are given to the exposing means 3 from an external device or the like, its laser diode emits light in response to the image formation signals, and the light is projected in the form of a beam of light onto the polygon mirror, which is being rotated at a high speed by the scanner motor. Then, the beam of light is reflected by the polygon mirror, is projected through the focusing lens, and is projected onto the reflection mirror, so that the peripheral surface of the photoconductive member 1 is scanned by the beam of light. As a result, the numerous points of the uniformly charged peripheral surface of the photoconductive member 1 are selectively exposed, forming thereby an electrostatic latent image on the peripheral surface of the photoconductive member 1.

In synchronism with the formation of an electrostatic latent image on the photoconductive member 1, the developing apparatus 4 is driven to orbitally move one of the developing devices, for example, the yellow component developing device 4Y,

into the development position. In the development position, voltage is applied to the development roller 4a to adhere the yellow developer to the electrostatic latent image on the photoconductive member 1, in order to develop the latent image.

Next, such voltage that is opposite in polarity to the developer is applied to the pressing roller (primary transfer roller) 5j, which keeps the transfer belt 50a pressed on the photoconductive member 1. As a result, the image on the photoconductive member 1 formed of the yellow developer, is transferred (primary transfer) onto the transfer belt 5a.

As the primary transfer of the image formed of the yellow developer is completed as described above, another developing device, for example, the magenta component developing device (4M), of the developing apparatus 4 is orbitally moved into the development position, and is locked into the position, where it opposes the photoconductive member 1. The above described process for forming an electrostatic latent image, process for forming a developer image, and process for transferring (primary transfer) a developer image, are sequentially repeated for magenta (M), cyan (C), and black (Bk) color components. As a result, four developer images different in color are layered on the transfer belt 5a.

Meanwhile, the secondary transfer roller 11 is kept in a position in which it does not contact the transfer belt 5a, and so is the cleaning charge roller 5f as a cleaning unit.

After the formation of the four developer images different in color on the transfer belt 5a, the secondary transfer roller 11 is pressed on the transfer belt 5a as shown in Figure 1. In addition, in synchronism with this pressing of the secondary transfer roller 11, a recording medium P kept on standby in a predetermined position in the adjacencies of a pair of registration rollers 7, as a conveying means, is sent into the nip between the transfer belt 5a and secondary transfer roller 11.

To the transfer roller 11, such bias voltage that is opposite in polarity to the developers is being applied. Therefore, the developer images on the transfer belt 5a are transferred (secondary transfer) all at once onto the surface of the recording medium P as the recording medium P is sent into the nip.

Next, the recording medium P on which the developer images have been transferred as described above is conveyed to the fixing means 8 by a conveyer belt unit 12. In the fixing means 8, the plurality of developer images are fixed by the pressure roller and heat roller of the fixing means 8. Then, the recording medium P is conveyed by a pair of discharge

rollers 13 along a discharge guide 15. Thereafter, the recording medium P is discharged into a delivery tray 10 on top of the color image forming apparatus A. Incidentally, designated by a referential number 18 is a conveyance roller.

Meanwhile, the cleaning charge roller 5f is pressed upon the transfer belt 5a after the transfer, and a predetermined bias voltage is applied to the cleaning charge roller 5f, removing thereby the residual charge from the transfer residual developer, that is, the developer which remained on the transfer belt 5a after the transfer. The transfer residual developer from which electrical charge has been removed is transferred back onto the photoconductive member 1 from the transfer belt 5a, in the nip between the photoconductive member 1 and transfer belt 5a; the surface of the transfer belt 5a is cleaned. The transfer residual developer having been transferred back onto the photoconductive member 1 is removed and recovered by the cleaning blade 6 for the photoconductive member 1. The recovered residual developer is conveyed as removed developer through a conveyance path specified therefor, and is collected into removed developer storage portion 216.

The developing apparatus 4 removably holds four development cartridges (4Bk, 4M, 4Y, and 4C) storing four developers, one for one, different in

color, that is, black (Bk), magenta (M), yellow (Y), and cyan (C) developers. The development cartridges are removably fixed in predetermined positions, one for one, in the development rotary 70 of the developing apparatus 4. The development rotary 70 is rotated about its center shaft, and is provided with a pair of rotary flanges (unshown), in the form of a disc, which are solidly fixed to the two ends of the center shaft, one for one. With this solid fixation of the pair of flanges, the development cartridges do not disengage from the development rotary 70 even if the development rotary 70 rotates. In order to take a given development cartridge out of the main assembly of the image forming apparatus, the development cartridge is to be pulled by its handle (unshown); the operation for mounting or dismounting a development cartridge can be carried out by a user.

The development cartridges (4Bk, 4M, 4Y, and 4C) have a developer storage portion and a development portion. The developer storage portion is filled with developer of a specific color. As a stirring means rotates, the developer is conveyed to the development portion. In the development portion, as a developer supply roller rotates, the developer from the developer storage portion is supplied to the surface of the development roller. In addition, the developer is formed into a thin layer by the development blade,

while being electrically charged by the friction between the developer and the combination of the development blade and development roller. Then, as development bias is applied to the development roller while the development roller is rotated, the thin layer of the developer on the development roller develops the electrostatic latent image on the photoconductive drum. Next, referring to Figures 2 - 7, a single-piece process cartridge formed by unitizing the photoconductive member unit and intermediary transfer member unit will be described.

Figure 2 is a vertical sectional view of the left side of the process cartridge 20 as seen from the front side of the image forming apparatus, and Figure 3 is a perspective view of the cartridge 20 as seen from the left side. Figure 4 is a perspective view of the cartridge 20 as seen from the right side, and Figure 5 is a side view of the cartridge 20, for showing the structure of the drum shutter. Figure 6 is a sectional view of the removed developer storage box 216, at a plane parallel to the bottom of the image forming apparatus, and Figure 7 is a left side view of the cartridge 20, the left side cover of which has been removed. Referring to Figure 2, the cartridge 20 comprises a drum unit 21 and a transfer member unit 22. The drum unit 21 has the photoconductive drum, and a photoconductive member

frame 129 for rotationally supporting the photoconductive member 1. The transfer member unit 22 has the transfer belt 5a and removed developer storage portion 216. The drum unit 21 is above the transfer member unit 22, in terms of the direction in which the cartridge 20 is projected in Figure 6. The left and right side covers 260 and 261 (Figures 3 and 4) are solidly fixed to the lengthwise ends of the transfer member unit 22, one for one. The covers 260 and 261 extend far enough to cover the lengthwise ends of the photoconductive member unit 21 as well, holding thereby the photoconductive member unit 21 from the lengthwise ends thereof.

In the drum unit 21, the photoconductive drum 1 is rotationally attached to the photoconductive member frame 129 (cartridge frame 20a) with the interposition of the left bearing 102 (Figure 3) and right bearing 106 (Figure 4). A predetermined amount of force for rotationally driving the photoconductive drum 1 is transmitted to the photoconductive drum 1 from the main assembly of the image forming apparatus through a coupling 124 (Figure 4) attached to the right lengthwise end of the photoconductive member 1.

Referring to Figure 2, the photoconductive member 1 is in contact with the charge roller 2, which is kept pressed upon the photoconductive member 1 by a pair of compression springs 126, with the

interposition of a pair of bearings 125 located at the lengthwise ends of the charge roller 2 one for one. With the provision of this structural arrangement, the charge roller 2 is rotated by the rotation of the photoconductive member 1. At least one of the pair of bearings 125 is formed of an electrically conductive material, so that a predetermined charge bias voltage can be applied to the charge roller 2 through the bearing 125 to uniformly charge the peripheral surface of the photoconductive member 1. Incidentally, the charge roller 2, bearings 125, and springs 126 are integral parts of the charge roller unit 140.

The drum unit 21 is provided with a drum shutter 119, which is opened or closed by the operation for mounting the cartridge 20 into the image forming apparatus main assembly 100, or removing it therefrom, respectively. The shutter 119 is for protecting the drum 1.

The shutter 119 is rotatably attached to the side covers 260 and 261, with the interposition of an auxiliary arm 121, one end of which is rotatably attached to the arm attachment portion 121a of the cover 260, and the other end is rotatably attached to the arm attachment portion 121b of the shutter 119. Further, the drum unit 21 is provided with an arm 120, which is under the pressure generated by the resiliency of a spring 123 in the closing direction of

the shutter 119. The arm 120 is rotatably attached to the shutter shaft 124 of the cover 260. One end of the arm 120 is provided with a claw 120a, with which the arm 120 is attached to the arm attachment portion 120b of the shutter 119. Designated by a referential number 122 is a retainer ring, which prevents the arm 120 from disengaging from the shaft 124 (Figures 3 and 10).

The cartridge frame 20a (photoconductive member frame 129) holds the cleaning blade 6, which is attached to a predetermined portion of the cartridge frame 20a. The transfer residual developer, that is, the developer remaining on the transfer belt 5a after the image transfer from the transfer belt 5a, is recovered onto the photoconductive member 1, and then, is scraped away, along with the development residual developer, that is, the developer remaining on the photoconductive member 1 after the image transfer from the photoconductive member 1, by the blade 6. After being scraped away from the photoconductive member 1 by the blade 6, the removed developer is stored in the removed developer storage portion 216 of the transfer member unit 22. The means for conveying the removed developer to the removed developer storage portion 216 will be described later.

Next, the intermediary transferring apparatus 5, which constitutes the transfer member unit 22, will

be described. The transfer belt 5a of the transferring apparatus 5 is stretched around the driving roller 240 and following roller 241, which are supported by the frame 245 of the transfer member unit 22. The driving roller 240 is rotatably attached to the transfer member unit 22 by its lengthwise ends, with the interposition of the left bearing 201 (Figure 3) and right bearing 202 (Figure 4). A predetermined amount of force for rotationally driving the driving roller 240 is transmitted to the driving roller 240 through the coupling 242 (Figure 4) attached to the right lengthwise end of the driving roller 240. A pair of bearings 243 which are supporting the following roller by its lengthwise ends, are provided with a pair of compression springs 244, one for one, which provide the transfer belt 5a with a predetermined amount of tension.

The transferring apparatus 5 is provided with a primary transfer roller 5j, which is positioned in a manner to sandwich the transfer belt 5a between itself and photoconductive member 1, being supported by a pair of bearings 246, by its lengthwise ends. The primary transfer roller 5j is kept pressed against the photoconductive member 1 by the resiliency of a pair of compression springs 247, with the transfer belt 5a sandwiched between the primary transfer roller 5j and photoconductive member 1. With the provision of this

structural arrangement, the primary transfer roller 5j is rotated by the rotation of the photoconductive member 1. At least one of the pair of bearings 246 is made of an electrically conductive material, making it possible to apply a predetermined transfer bias voltage to the primary transfer roller 5j in order to transfer (primary transfer) the developer on the photoconductive member 1 onto the transfer belt 5a.

The transferring apparatus 5 is also provided with a cleaning charge roller portion 223, which is positioned in a manner to oppose the driving roller 240, with the interposition of the transfer belt 5a. The residual electrical charge of the residual developer on the transfer belt 5a is removed by the cleaning charge roller portion 223; it is removed by applying a predetermined bias to the cleaning charge roller 5f of the cleaning charge roller portion 223. The cleaning charge roller 5f is supported by a pair of bearings 211, by its lengthwise ends. Further, the cleaning charge roller 5f is kept pressed against the driving roller 240, with the transfer belt 5a sandwiched between the two rollers 5f and 240, by a pair of compression springs 212. With the provision of this structural arrangement, the cleaning charge roller 5f is rotated by the rotation of the transfer belt 5a (driving roller 240). At least one of the pair of bearings 211 is made of an electrically

conductive material. To the cleaning charge roller 5f, a predetermined bias voltage is applied so that the residual electrical charge of the developer on the transfer belt 5a is removed. Then, the residual developer on the transfer belt 5a is electrostatically transferred back onto the photoconductive member 1, in the primary transfer nip, and is removed from the photoconductive member 1 by the cleaning blade 6. Then, the removed residual developer is stored in the removed developer storage portion 216, as described before.

Next, the residual developer conveying means, that is, the means for conveying the removed residual developer will be described.

The transfer member unit 22 has the removed developer storage portion 216, which is located on the opposite side of the transfer belt 5a with respect to the photoconductive member unit 21. The removed developer storage portion 216 comprises a part of the intermediary transfer member frame 245 and a certain number of partitioning plates 250 welded thereto. It is the final storage for the residual developer from the photoconductive member 1.

As the residual developer is scraped away from the photoconductive member 1 by the blade 6, it is prevented by a developer catching sheet 124 from falling onto the transfer belt 5a, and accumulates on

the developer catching sheet 124. Then, as a developer conveying sweeping blade 151 is rotated, the removed developer having accumulated on the developer catching sheet 124 is swept into the deeper section of the photoconductive member frame 129, that is, swept out in the direction to be moved away from the photoconductive member 1. Then, it is conveyed further leftward, as seen from the front side of the apparatus (frontward in Figure 2), by the rotation of a first screw 128 located more inward of the photoconductive member frame 129 than the developer conveying sweeping blade 151. The sweeping blade 151 is rotatably supported by the frame 20a with the interposition of a pair of sweeping blade bearings 151a (Figure 16). The frame 20a is provided with a hole 152, which is at the left lengthwise end of the first screw 128, and through which the removed developer falls after being conveyed leftward by the first screw 128. Then, the removed developer is sent to the receiving hole 253a of a cover 253 for a bladed wheel 255, which leads to the removed developer storage portion 216. The frame 20a is provided with a sealing member 254, which is attached to the bottom edge of the hole 152, preventing thereby the developer from leaking from the joint between the holes 152 and 253a. The box 216 is a part of the unit 22. Referring to Figure 5, the cover 253 for the bladed

wheel 255 is attached to the left side of the transfer member frame (cartridge frame 20a) 245, with a sealing member 256 sandwiched between them. Disposed on the inward side of the cover 253 is the bladed wheel 255, which is rotated in the counterclockwise direction, as seen from the left side, conveying thereby the removed developer toward the box 216. The cover 253 overlaps with the left side of the storage portion 216. The portion of the cover 253, which overlaps with the storage portion 216, is provided with a hole, which leads to the interior of the bladed wheel cover 253. Further, the frame 20a is provided with a second screw 258, which extends through this hole of the overlapping portion, in the lengthwise direction of the frame 20a. Thus, as the screw 258 is rotated, the removed developer having been conveyed thereto by the bladed wheel 255 is conveyed from the left side of the storage portion 216 to the deeper end of the right side thereof. The storage portion 216 has a plurality of small chambers created by partitioning the storage portion 216 with the plurality of vertical partitioning walls. As the removed developer is conveyed into the storage portion 216, the small chambers of the storage portion 216 are sequentially filled, starting from the leftmost chamber. The rightmost chamber is provided with a detection portion 269 for detecting that the box 216 is full of the

developer. The detection portion 269 comprises a light emitting portion and a light receiving portion. It compares the amount of the light the light receiving portion receives when there is no removed developer, with the amount of the light receiving portion receives when the light from the light emitting portion is blocked by the removed developer, in order to determine whether or not the storage portion 216 is full. Further, the detection portion 269 is provided with a wiping member 270 for wiping the light emitting surface 269a and light receiving surface 269b. The wiping member 270 comprises: a rotational axle 270b located at the mid point between the light emitting surface 269a and light receiving surface 269b; and a piece of flexible sheet 270a attached to the rotational axle 270b. Thus, as the rotational axle 270b is rotated, the piece of flexible sheet 270a wipes away the residual developer on the light emitting surface 269a and light receiving surface 296b.

Next, referring to Figure 7, the structural arrangement for transmitting driving force to the residual developer conveying means will be described.

As described above, a predetermined amount of force for rotationally driving the photoconductive member 1 and driving roller 240 are transmitted thereto from the main assembly of the image forming

apparatus through couplings 124 and 242 located at the right lengthwise end of the process cartridge 20. The driving roller 240 is provided with a gear 262 which is attached to the left lengthwise end of the driving roller 240. The force from the apparatus main assembly is further transmitted to a gear 271 attached to the lengthwise end of the rotational shaft 270b of the aforementioned wiping member 270 from the gear 262 through two gears 267 and 268. The gear 271, and the gear 268, that is, the gears immediately preceding the gear 262 in terms of the driving force transmission direction, are step gears. Thus, the speeds at which the driving portion related to the residual developer conveyance, that is, the portions on the downstream side in terms of the driving force transmission direction, are rotationally driven, are slower than the speed at which the driving roller 240 is driven. Further, the driving force is transmitted from the gear 271 through the gear 266 to a gear 264 attached to the second screw 258, and a gear connected to the bladed wheel 255. Then, the driving force is transmitted from the bladed wheel gear 263 to a gear 265 located next to the photoconductive member unit 21. The above listed gears, that is, the gears from the gear 262 to the gear 265, are disposed on the left side of the intermediary transfer unit 22. In comparison, the photoconductive member unit 21 is

provided with a gear 130, which is attached to the left lateral wall of the photoconductive member unit 21, being located next to the intermediary transfer unit 22. The gear 130 is attached to the first screw 128, and receives the driving force from the gear 265. From the gear 130, the driving force is transmitted through another gear to a gear 131 attached to the aforementioned developer conveying sweeping blade 151. The gears 130 and 131 are attached to the bladed wheel unit 259, as shown in Figures 18 and 19. To the unit 259, one end of the second screw 258 is attached.

As described above, the process cartridge 20 is structured so that all the gears involved in the residual developer conveyance are disposed at the left end of the process cartridge 20 to transmit the driving force to the residual developer conveying means.

Next, the method for remanufacturing the process cartridge 20 will be described (Figures 8 - 20).

First, the method for removing the photoconductive member 1 from the process cartridge 20 (frame 20a) will be described.

(1) Method for Removing Drum 1 (attachment process is reversal to removal process)

1. Remove the left and right pins 150 and 151 by pinching them with a nipper or the like

(Figures 3 and 8).

2. Separate the drum unit 21 from the transfer member unit 22; pull the rear portion of the drum unit 21 frontward from the transfer member unit 22 (Figure 9).

3. Remove the retainer ring 122 from the shutter shaft 124, and remove the claw 120a of the arm 120 from the arm attachment portion 120b of the shutter 119 to remove the arm 120 from the shutter 119 and cover 260. Then, remove the spring 128 on the inward side of the cover (Figure 10).

4. Remove the auxiliary arm 121 from the auxiliary arm attachment portions 121a of the covers 260 and 261 by widening the distance between the opposing ends of the auxiliary arm 121 by pushing the opposing ends with hands, and remove the combination of the shutter 119 and auxiliary arm 121 from the covers 260 and 261 (Figure 11). Incidentally, the auxiliary arm attachment portion 121a of the cover 261 is not shown.

5. Remove the two small screws M2 in the front, and remove the charge roller unit 140 from the frame 20a (Figure 12).

6. Remove the three small screws M4 from the lateral walls of the frame 20a, and then, remove the left and right drum shaft supporting members 102, and drum bearing supporting member (photoconductive member

frame 129) 106 (Figure 13).

7. Remove the photoconductive member 1 from the photoconductive member unit 21; first, the right side of the drum 1 is to be pulled out frontward, and then, the entirety of the drum 1 is to be pulled out frontward (Figure 14).

Next, the method for removing the removed developer will be described.

(2) Removal of Removed Developer

(1) Extraction of Removed Developer from Photoconductive Member Unit 22

* Continuation of the above described Steps 1 - 7 (steps after removal of drum 1)

8. Remove the two small screws M5 from the front wall of the frame 20a, and remove the cleaning blade 6 from the frame 20a. Further, remove the two small screws M6 from the front wall of the frame 20a, and remove the developer catching sheet holding metallic plate 127 from the frame 20a (Figure 15).

9. Remove the sweeping blade bearing 151a from the left wall of the frame 20a, and remove the sweeping blade 151 from the frame 20a from the front side of the frame 20a (Figure 16).

10. Remove the removed developer having accumulated in the unit 22, with the use of a cleaner S or the like, from the front side of the unit 22 (Figure 17).

To describe in more detail, the developer is to be removed with the use of the cleaner S, for example, a vacuum cleaner, through the opening 20b exposed by the removal of the various components through the above described steps.

(2) Extraction of Removed Developer from Intermediary Transfer Member Unit 22

* Continuation of Operations 1 and 2, on the intermediary transfer member unit side, after the separation of the transfer member unit 21 from the drum unit 20.

11. Remove the four small screws M7 from the right wall of the frame 20a, and remove the right side cover 260 and transfer member frame 245 from the frame 20a (Figure 18).

12. Remove two small screws M8 from the right wall of the frame 20a, and pull out the screw unit 259 (in the rightward in Figure 19). During this process, the developer leaks through the gap resulting from the removal the screw unit 259, and the leaked developer is to be removed with the use of the cleaner S or the like. The screw unit 259 is to be pulled out far enough for the screw 258 to completely come out of the transfer member unit 22 (Figure 19).

13. Remove the developer from the removed developer storage box 216 through the hole 216a of the right wall of the frame 20a, with the use of the

cleaner S or the like, while holding the transfer member unit 22 upside down, or holding it with the right wall facing downward (Figure 20).

Incidentally, the cleaner S is schematically shown in the drawing, and the suctioning portion connected to the nozzle S1 is not shown.

The steps for attaching the components removed through the above described steps are steps opposite to the steps through which the components were removed. The components are attached with the small screws M1 - M8.

Next, the method for remanufacturing the process cartridge 20 comprising the transfer member unit 22 having the above described transfer belt 5a, and the drum unit 21 having the electrophotographic photoconductive drum 1, will be described.

The process cartridge remanufacturing method comprises:

(i) Pin removing step for removing a pair of pins 150 and 151, which are attached to the lengthwise ends of the process cartridge 20, one for one, to keep the transfer member unit 22 and drum unit 21 joined;

(ii) Drum removing step for removing the drum unit 21 from the transfer member unit 22;

(iii) End cover removing step for removing the end cover 260 attached to one of the lengthwise ends of the transfer member unit 22;

(iv) Screw unit removing step for removing the screw unit 259 having: the screw 258 anchored to the removed developer storage portion 216 which is for storing the developer removed from the electrophotographic photoconductive drum 1; the gear 264 for transmitting the driving force to the screw 258; and entrance hole 259a through which the removed developer from the drum unit 21 is stored into the removed developer storage portion 216. Incidentally, in this step, the screw 258 disposed within the removed developer storage portion 216 is to be pulled out through the screw hole 216a of the removed developer storage portion 216, when removing the screw unit 259 from the transfer member unit frame 22a;

(v) Developer removing step for removing the developer in the removed developer storage portion 216, through the screw hole 216a;

(vi) Screw unit attaching step for inserting the screw 258 into the removed developer storage portion 216 through the screw hole 216a, and attaching the screw unit 259 to the transfer member unit frame 22a;

(vii) End cover attaching step for attaching the end cover 260 to one of the lengthwise ends of the transfer member unit 22; and

(viii) Joining step for joining the transfer member unit 22 with the drum unit 21, with the pins

150 and 151.

The process cartridge remanufacturing method further comprises:

pressure applying member removing step for removing from the cartridge frame 20a the combination of the arm 120 and spring 123, as a pressure applying member, which is attached to one of the lengthwise ends of the process cartridge 20 to keep the drum shutter 119 pressured in the closing direction;

charge roller unit removing step for removing the charge roller unit 140, which is supporting the charge roller 2, from the cartridge frame 20a;

drum shaft supporting member removing step for removing the drum shaft supporting member 102 integral with the drum shaft 102a which is attached to one of the lengthwise ends of the process cartridge 20 and is supporting one of the lengthwise ends of the electrophotographic photoconductive member 1;

drum bearing supporting member removing step for removing the drum bearing supporting member 106 attached to the other lengthwise end of the process cartridge 20 and integral with the drum bearing 106a which is supporting the drum shaft 1a (Figure 4) attached to the other end of the electrophotographic photoconductive member 1;

drum removing step for removing the electrophotographic photoconductive member 1 from the

cartridge frame 20a;

drum inserting step for inserting a brand-new electrophotographic photoconductive member 1 into the cartridge frame 20a;

drum shaft supporting member attaching step for attaching the drum shaft supporting member 102 integral with the drum shaft 102a for supporting one of the lengthwise ends of the inserted brand-new electrophotographic photoconductive member 1, to the corresponding lengthwise end of the cartridge frame 20a, in order to support the lengthwise end of the electrophotographic photoconductive member 1 by the corresponding lengthwise end of the cartridge frame 20a;

drum bearing supporting member attaching step for attaching the drum bearing supporting member 106 integral with the drum bearing 106a for supporting the drum shaft 1a (Figure 4), with which the other lengthwise end of the brand-new electrophotographic photoconductive member 1 having just been inserted into the cartridge frame 20a is provided, to the other lengthwise end of the cartridge frame 20a in order to support the other lengthwise end of the electrophotographic photoconductive member 1 by the other end of the cartridge frame 20a;

charging unit attaching step for attaching the charge roller unit 140, which is supporting the

charge roller 2, to the cartridge frame 20a; and

pressuring means attaching step for attaching to one of the lengthwise ends of the cartridge frame 20, the combination of the arm 120 and spring 123, as a pressuring means, for keeping pressured in the closing direction, the drum shutter attached to one of the lengthwise ends of the process cartridge 20.

The process cartridge remanufacturing method further comprises:

shutter arm removing step for removing, prior to the drum shaft supporting member removing step and drum bearing supporting member removing step, the auxiliary arm 121, which is supporting the drum shutter 119, and the two ends of which are attached to the lengthwise ends of the cartridge frame 20a, one for one, by disengaging the two ends of the auxiliary arm 121 from the cartridge frame 20a; and

shutter arm attaching step for attaching, after the charge unit attaching step, the two ends of the auxiliary arm 121 to the lengthwise ends of the cartridge frame 20a, one for one.

Further, the process cartridge remanufacturing method comprises:

cleaning blade removing step for removing the cleaning blade 6 from the cartridge frame 20a, after the removal of the electrophotographic photoconductive member 1 from the cartridge frame 20a, and before the

attachment of the brand-new electrophotographic photoconductive member 1; and

developer removing step for removing the developer, which has been removed from the electrophotographic photoconductive member 1 by the cleaning blade 6, through the hole of the storage portion exposed by the removal of the cleaning blade 6.

The process cartridge remanufacturing method also comprises:

guiding member removing step for removing, between the cleaning blade removing step and developer removing step, the flexible guiding member for guiding the developer, which has been removed from the electrophotographic photoconductive member 1 by the cleaning blade 6, to the hole 20b of the storage portion 20c.

In the above described process cartridge remanufacturing method, the developer adhering to the screw 258 is to be suctioned away by the suctioning device S, when the screw 258 disposed within the removed developer storage portion 216 is pulled out through the screw hole 216a of the removed developer storage portion 216.

According to the above described process cartridge remanufacturing method, the gears 263 - 266, the portion having the entrance hole 259a, and the

screw 258, can be removed together, in the screw unit removing step, improving thereby the process cartridge remanufacture efficiency. Further, the aforementioned gears 263 - 266, the portion with the entrance hole 259a, and the screw 258, can be attached together, in the screw unit attaching step, also improving the process cartridge remanufacture efficiency. In other words, the above described process cartridge remanufacturing method simplifies the process cartridge remanufacture.

Additionally, the present invention is inclusive of all of the cases described below.

(1) The case in which a cartridge is remanufactured using only the components from a single used process cartridge.

(2) The case in which a cartridge remanufactured using only the components from a single used process cartridge like in Case (1), except that the components which cannot be reused, for example, damaged components or those the service lives of which have expired, are replaced with brand-new components or the reusable components from the other used process cartridges.

(3) The case in which various components removed from a plurality of used cartridges are sorted into groups of the same components, and cartridges are remanufactured by selecting the necessary components

from the sorted components.

(4) The case in which various components removed from a plurality of used cartridges are sorted into groups of the same components as in Case (3), and cartridges are remanufactured by selecting the necessary components from the sorted components, except that the components which cannot be reused, for example, damaged components or those the service lives of which have expired, are replaced with brand-new components or the reusable components from the other used process cartridges.

The aforementioned components means the components, members, portions, etc., which constitute certain portions of a process cartridge. They also means the smallest units into which a process cartridge can be disassembled.

According to the above described embodiments of the present invention, a process cartridge can be simply remanufactured by removing screws or the like. Therefore, the cartridge frame or the like are not damaged during the cartridge remanufacture.

Also according to the above described embodiments, the developer in the drum unit 21 can be removed through the hole 20 of the photoconductive drum frame 129 (cartridge frame), simplifying thereby process cartridge manufacture.

Also according to the above described

embodiments, the developer in the transfer member unit 22 can be removed through the screw hole 216a through which the force for rotationally driving the screw 258 is transmitted to the screw 258. In other words, the screw hole 216a can also be used for developer removal, simplifying thereby process cartridge manufacture.

As described above, the present invention simplifies process cartridge remanufacture.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth, and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.